

What is claimed is:

1. A method for presenting weather data and related data for use in aviation, the method comprising:

providing presently measured or estimated values for each of a selected subset of a set of selected situation parameters, where the situation parameter set comprises trip length, present phase of trip, trip departure time, distance from present location to a selected aircraft destination, visibility, ceiling or cloud cover, longitudinal wind speed, cross wind speed, wind gust speed, temperature, dew point and density altitude;

providing a reference database containing a collection of  $N$  reference situations, numbered  $n = 1, \dots, N$  ( $N \geq 2$ ), with each reference situation being characterized by an ordered set of parameter value ranges, one range for each of the selected subset of parameters; and

when the measured or estimated value of each situation parameter in the selected subset lies within the corresponding value range for the parameter, displaying a selected subset of weather data, in at least one of visually perceptible format and audibly perceptible format, where the subset of weather data is drawn from a set of weather data that comprises a measured value or estimated value of at least one of aircraft present altitude, static air pressure at aircraft present altitude, longitudinal wind speed, crosswind speed, wind gust speed, wind variability, wind vector direction, temperature, dew point, temperature-dewpoint spread, density altitude, sky condition for at least one altitude range, ground visibility at a selected aircraft destination, ground precipitation at the selected destination, visibility obscurations along aircraft flight route, ceiling, distance from the selected destination, fuel required to reach the selected destination, recommended runway

for the selected destination, and time of most recent measurement upon which the subset of weather data is based.

2. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: (1) trip phase being one of {pre-departure, takeoff, ascent and cruise}, AND (2)  $v_w(\text{present};\text{dest}) - v_w(\text{forecast};\text{dest}) \geq \Delta v_w(\text{thr})$ , where  $\Delta v_w(\text{thr})$  is a selected positive value; and

when each of the selected set of conditions is satisfied, displaying estimated fuel required to move from aircraft present location to said destination in at least one of a visually perceptible format and an audibly perceptible format.

3. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set conditions consisting of: (1) trip phase being one of {pre-departure, takeoff, ascent and cruise}, AND (2) at least one of the following inequalities is satisfied:

{  $\{\Delta T(\text{dew};\text{dest}) \leq \Delta T(\text{dew};\text{thr})\}$  OR  $\{\text{VIS}(\text{dest}) \leq \text{VIS}(\text{dest};\text{thr})\}$  OR  $\{\text{Ce}(\text{dest}) \leq \text{Ce}(\text{dest};\text{thr})\}$  OR  $\{v_w(\text{long};\text{dest}) \geq v_w(\text{long};\text{thr})\}$  OR  $\{v_w(\text{cr};\text{dest}) \geq v_w(\text{cr};\text{thr})\}$  }, where  $\Delta T(\text{dew};\text{thr})$ ,  $\text{VIS}(\text{dest};\text{thr})$ ,  $\text{Ce}(\text{dest};\text{thr})$ ,  $v_w(\text{long};\text{thr})$  and  $v_w(\text{cr};\text{thr})$  are selected threshold values; and

when each of the selected set of conditions is satisfied, displaying at least one of  $\Delta T(\text{dew};\text{dest})$ ,  $\text{VIS}(\text{dest})$ ,  $\text{Ce}(\text{dest})$ ,  $v_w(\text{long};\text{dest})$  and  $v_w(\text{cr};\text{dest})$  in at least one of a visually perceptible format and an audibly perceptible format.

4. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: (1) trip phase being one of {pre-departure, takeoff, ascent and cruise}, AND (2) at least one of the following inequalities is satisfied:  $\{\{VIS(dest) \leq VIS(dest;thr)\} \text{ OR } \{Ce(dest) \leq Ce(dest;thr)\} \text{ OR } \{v_w(long;dest) \geq v_w(long;thr)\} \text{ OR } \{v_w(cr;dest) \geq v_w(cr;thr)\}\}$ , where  $VIS(dest;thr)$ ,  $Ce(dest;thr)$ ,  $v_w(long;thr)$  and  $v_w(cr;thr)$  are selected threshold values; and

when each of the selected set of conditions is satisfied, displaying at least one of  $VIS(dest)$ ,  $Ce(dest)$ ,  $v_w(long;dest)$  and  $v_w(cr;dest)$  in at least one of a visually perceptible format and an audibly perceptible format.

5. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: (1) trip phase being one of {approach}, AND (2) at least one of the following inequalities is satisfied:  $\{\{h(dens;dest) \geq h(dens;dest;thr)\} \text{ OR } \{VIS(dest) \leq VIS(dest;thr)\} \text{ OR } \{Ce(dest) \leq Ce(dest;thr)\} \text{ OR } \{v_w(long;dest) \geq v_w(long;thr)\} \text{ OR } \{v_w(cr;dest) \geq v_w(cr;thr)\}\}$ , where  $h(dens;dest;thr)$ ,  $VIS(dest;thr)$ ,  $Ce(dest;thr)$ ,  $v_w(long;thr)$  and  $v_w(cr;thr)$  are selected threshold values; and

when each of the selected set of conditions is satisfied, displaying at least one of  $h(dens(dest;thr)$ ,  $VIS(dest)$ ,  $Ce(dest)$ ,  $v_w(long;dest)$ ,  $v_w(cr;dest)$  and recommended runway at said selected destination in at least one of a visually perceptible format and an audibly perceptible format.

6. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: (1) trip phase being one of {approach}, AND (2) at least one of the following inequalities is satisfied:  $\{ \{ \text{VIS}(\text{dest}) \leq \text{VIS}(\text{dest};\text{thr}) \}$  OR  $\{ \text{Ce}(\text{dest}) \leq \text{Ce}(\text{dest};\text{thr}) \}$  OR  $\{ v_w(\text{long};\text{dest}) \geq v_w(\text{long};\text{thr}) \}$  OR  $\{ v_w(\text{cr};\text{dest}) \geq v_w(\text{cr};\text{thr}) \} \}$ , where  $\text{VIS}(\text{dest};\text{thr})$ ,  $\text{Ce}(\text{dest};\text{thr})$ ,  $v_w(\text{long};\text{thr})$  and  $v_w(\text{cr};\text{thr})$  are selected threshold values; and

when each of the selected set of conditions is satisfied, displaying at least one of  $\text{VIS}(\text{dest})$ ,  $\text{Ce}(\text{dest})$ ,  $v_w(\text{long};\text{dest})$ ,  $v_w(\text{cr};\text{dest})$  and recommended runway at said selected destination in at least one of a visually perceptible format and an audibly perceptible format.

7. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: (1) trip phase being one of {cruise}, AND (2) at least one of the following inequalities is satisfied:  $\{ \{ h(\text{dens};\text{NANYFB}) \geq h(\text{dens};\text{NANYFB};\text{thr}) \}$  OR  $\{ \text{VIS}(\text{NANYFB}) \leq \text{VIS}(\text{NANYFB};\text{thr}) \}$  OR  $\{ \text{Ce}(\text{NANYFB}) \leq \text{Ce}(\text{dest};\text{thr}) \} \}$ , where  $h(\text{dens};\text{NANYFB};\text{thr})$ ,  $\text{VIS}(\text{NANYFB};\text{thr})$  and  $\text{Ce}(\text{NANYFB};\text{thr})$  are selected threshold values and “NANYFB” refers to an airport within a selected transverse distance from said flight route that has not yet been flown past by said aircraft; and

when each of the selected set of conditions is satisfied, displaying at least one of location of NANYFB,  $h(\text{dens}(\text{NANYFB};\text{thr})$ ,  $\text{VIS}(\text{NANYFB})$ ,  $\text{Ce}(\text{NANYFB})$  and recommended runway at said selected destination in at least one of a visually perceptible format and an audibly perceptible format.

8. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: (1) trip phase being one of {cruise}, AND (2) at least one of the following inequalities is satisfied:  $\{ \{ \text{VIS}(\text{NANYFB}) \leq \text{VIS}(\text{NANYFB}; \text{thr}) \} \text{ OR } \{ \text{Ce}(\text{NANYFB}) \leq \text{Ce}(\text{dest}; \text{thr}) \} \}$ , where  $\text{VIS}(\text{NANYFB}; \text{thr})$  and  $\text{Ce}(\text{NANYFB}; \text{thr})$  are selected threshold values and “NANYFB” refers to an airport within a selected transverse distance from said flight route that has not yet been flown past by said aircraft; and

when each of the selected set of conditions is satisfied, displaying at least one of location of NANYFB,  $\text{VIS}(\text{NANYFB})$ ,  $\text{Ce}(\text{NANYFB})$  and recommended runway at said selected destination in at least one of a visually perceptible format and an audibly perceptible format.

9. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected condition consisting of: at least one of the following inequalities is satisfied:  $\{ \{ \text{VIS}(\text{forecast}; \text{dest}) - \text{VIS}(\text{present}; \text{dest}) \geq \Delta \text{VIS}(\text{thr}) \}, \text{ OR } \{ \text{Ce}(\text{forecast}; \text{dest}) - \text{Ce}(\text{present}; \text{dest}) \geq \Delta \text{Ce}(\text{thr}) \} \text{ OR } \{ \Delta \text{T}(\text{dew}; \text{dest}) \leq \Delta \text{T}(\text{dew}; \text{thr}) \} \text{ OR } \{ \text{v}_w(\text{long}; \text{dest}) \geq \text{v}_w(\text{long}; \text{thr}) \} \text{ OR } \{ \text{v}_w(\text{cr}; \text{dest}) \geq \text{v}_w(\text{cr}; \text{thr}) \} \}$ , where  $\Delta \text{VIS}(\text{thr})$ ,  $\Delta \text{Ce}(\text{thr})$ ,  $\Delta \text{T}(\text{dew}; \text{thr})$ ,  $\text{v}_w(\text{long}; \text{thr})$  and  $\text{v}_w(\text{cr}; \text{thr})$  are selected positive values}; and

when the selected condition is satisfied, displaying at least one of  $\text{VIS}(\text{present}; \text{dest})$ ,  $\text{Ce}(\text{present}; \text{dest})$ ,  $\Delta \text{T}(\text{dew}; \text{dest})$ ,  $\text{v}_w(\text{long}; \text{dest})$  and  $\text{v}_w(\text{cr}; \text{dest})$  in at least one of a visually perceptible format and an audibly perceptible format.

10. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected condition consisting of: at least one of the following inequalities is satisfied  $\{\{VIS(\text{forecast}; \text{dest}) - VIS(\text{present}; \text{dest}) \geq \Delta VIS(\text{thr})\}, \text{OR } \{Ce(\text{forecast}; \text{dest}) - Ce(\text{present}; \text{dest}) \geq \Delta Ce(\text{thr})\} \text{ OR } \{v_w(\text{long}; \text{dest}) \geq v_w(\text{long}; \text{thr})\} \text{ OR } \{v_w(\text{cr}; \text{dest}) \geq v_w(\text{cr}; \text{thr})\}\}$ , where  $\Delta VIS(\text{thr})$ ,  $\Delta Ce(\text{thr})$ ,  $v_w(\text{long}; \text{thr})$  and  $v_w(\text{cr}; \text{thr})$  are selected positive values}; and

when the selected condition is satisfied, displaying at least one of  $VIS(\text{present}; \text{dest})$ ,  $Ce(\text{present}; \text{dest})$ ,  $v_w(\text{long}; \text{dest})$  and  $v_w(\text{cr}; \text{dest})$  in at least one of a visually perceptible format and an audibly perceptible format.

11. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: (1) trip phase being one of {cruise, descent, approach} AND (2)  $\{\Delta s(\text{dest}) \leq \Delta s(\text{thr})\}$  AND (3) at least one of the following inequalities is satisfied:  $\{\{v_w(\text{cr}; \text{dest}) \geq v_w(\text{cr}; \text{thr})\} \text{ OR } \{v_w(\text{gust}; \text{dest}) \geq v_w(\text{gust}; \text{thr})\}\}$ , where  $v_w(\text{cr}; \text{thr})$  and  $v_w(\text{gust}; \text{thr})$  are selected threshold values; and

when each of the selected set of conditions is satisfied, displaying at least one of  $v_w(\text{cr}; \text{dest})$ ,  $v_w(\text{gust}; \text{dest})$  and recommended runway at said selected destination in at least one of a visually perceptible format and an audibly perceptible format.

12. The method of claim 1, further comprising:

choosing at least one of said reference situations to comprise a selected set of conditions consisting of: for a set of METAR weather parameter values  $WP(METAR;m)$  and a set of corresponding TAF weather parameter values  $WP(TAF;m)$  ( $m = 1, \dots, M; M \geq 1$ ), a weather parameter difference,  $|WP(METAR;m) - WP(TAF;m)|$  is at least equal to a selected threshold value  $\Delta WP(m;thr)$  for at least one number,  $m=m'$ ; and

when the selected set of conditions is satisfied, displaying at least one of  $WP(METAR;m')$  and  $WP(TAF;m')$  in at least one of a visually perceptible format and an audibly perceptible format.

13. The method of claim 1, further comprising:

choosing at least one of said reference situations to further comprise a situation in which a trip length preference, including at least one of “short,” “medium” or “long,” is provided; and

displaying said selected subset of weather data for a given trip only if the length of the given trip is included in the provided trip length preference.

14. The method of claim 1, further comprising providing a reference database modification module that implements at least one of: (i) change of said range for at least one of said parameters in said selected subset; (ii) deletion of a parameter in said selected subset and deletion of said corresponding value range; (iii) addition of a parameter to said selected subset and addition of a corresponding value range for the added parameter; and (iv) specification of at least one of said visually perceptible display and said audibly perceptible display for said display of

said selected subset of weather data.

15. The method of claim 1, wherein said subset of said situation parameters is determined by a process comprising:

providing a selected subset of  $N1$  parameters, denoted  $p_{n1}$  ( $n1 = 1, \dots, N1$ ;  $N1 \geq 1$ ) from said set of situation parameters;

for a set of measured or estimated values of the parameter  $p_{n1}$ , for which a pilot requests said display of said selected set of weather data, providing a present-maximum value  $p_{n1}(\text{max}) = \text{maximum of measured or estimated values of the parameter } p_{n1}$ ; and

receiving a new measured or estimated value of the parameter  $p_{n1}$ , denoted  $p_{n1}(\text{new})$ , defining an updated present-maximum value of the parameter  $p_{n1}$  as  $p_{n1}(\text{max;updated}) = \max\{p_{n1}(\text{max}), p_{n1}(\text{new})\}$ , and replacing the value  $p_{n1}(\text{max})$  by the value  $p_{n1}(\text{max;updated})$ .

16. The method of claim 1, wherein said subset of said situation parameters is determined by a process comprising:

providing a selected subset of  $N2$  parameters, denoted  $q_{n2}$  ( $n2 = 1, \dots, N2$ ;  $N2 \geq 1$ ), from said set of situation parameters;

for a set of measured or estimated values of the parameter  $q_{n2}$ , for which a pilot requests said display of said selected set of weather data, providing a present-minimum value  $q_{n2}(\text{min}) = \text{minimum of measured or estimated values of the parameter } q_{n2}$ ; and

receiving a new measured or estimated value of the parameter  $q_{n2}$ , denoted  $q_{n2}(\text{new})$ , defining an updated present-minimum value of the parameter  $q_{n2}$  as



$q_{n2}(\text{min};\text{updated}) = \min\{q_{n2}(\text{min}), q_{n2}(\text{new})\}$ , and replacing the value  $q_{n2}(\text{min})$  by the value  $q_{n2}(\text{min};\text{updated})$ .

17. The method of claim 1, wherein said subset of said situation parameters is determined by a process comprising:

providing a selected subset of  $N3$  parameters, denoted  $r_{n3}$  ( $n2 = 1, \dots, N3$ ;  $N3 \geq 1$ ), from said set of situation parameters;

for a set of measured or estimated values of the parameter  $r_{n3}$ , for which a pilot requests said display of said selected set of weather data, providing a present-statistical average value  $r_{n3}(\text{avg}) = \text{average of measured or estimated values of the parameter } r_{n3}$ ; and

receiving a new measured or estimated value of the parameter  $r_{n3}$ , denoted  $r_{n3}(\text{new})$ , defining an updated present-average value of the parameter  $r_{n3}$  as  $r_{n3}(\text{avg};\text{updated}) = \text{average}\{r_{n3}(\text{avg}), r_{n3}(\text{new})\}$ , and replacing the value  $r_{n3}(\text{avg})$  by the value  $r_{n3}(\text{avg};\text{updated})$ .

18. The method of claim 1, wherein said subset of said situation parameters is determined by a process comprising

providing a selected subset of  $N4$  parameters, denoted  $r'_{n4}$  ( $n4 = 1, \dots, N4$ ;  $N4 \geq 1$ ), from said set of situation parameters;

for a set of measured or estimated values of the parameter  $r'_{n4}$ , for which a pilot requests said display of said selected set of weather data, providing a sequence of parameter value ranges,  $r'_{n4,j} < r'_{n4} \leq r'_{n4,j+1}$  ( $j = 1, \dots, J-1$ ;  $J \geq 2$ ); for the measured or estimated values of the parameter  $r'_{n4}$ ; and

receiving a new measured or estimated value of the parameter  $r'_{n4}$ , denoted  $r'_{n4}(\text{new})$ , and determining if the new parameter value satisfies  $r'_{n4,j} < r'_{n4}(\text{new}) \leq r'_{n4,j+1}$  for at least one of the parameter value ranges.

19. The method of claim 1, further comprising:

providing a list of alternate weather data comprising at least one of the following data items: METAR data, nearest IFR, nearest VFR, density altitude, wind velocity, cross wind, wind gust, visibility, ceiling, elevation, weather frequency, suggest runway at said selected destination, traffic pattern at said selected destination, airport information and highlight destination; and

verbally entering a selected audible display phrase including specification of one of the data items in order to provide an audibly perceptible display of information concerning the specified data item;

20. The method of claim 1, further comprising:

providing a list of alternate weather data comprising at least one of the following data items: METAR, nearest IFR, nearest VFR, density altitude, wind velocity, cross wind, wind gust, visibility, ceiling, elevation, weather frequency, suggest runway at said selected destination, traffic pattern, airport information and highlight destination; and

verbally entering a selected visual display phrase including specification of one of the data items in order to provide a visually perceptible display of information concerning the specified data item;

21. The method of claim 1, further comprising:

providing a list of alternate weather data comprising at least one of the following data items: METAR and highlight destination; and

visually entering a selected visual display phrase including specification of one of the data items in order to provide a visually perceptible display of information concerning the specified data item;